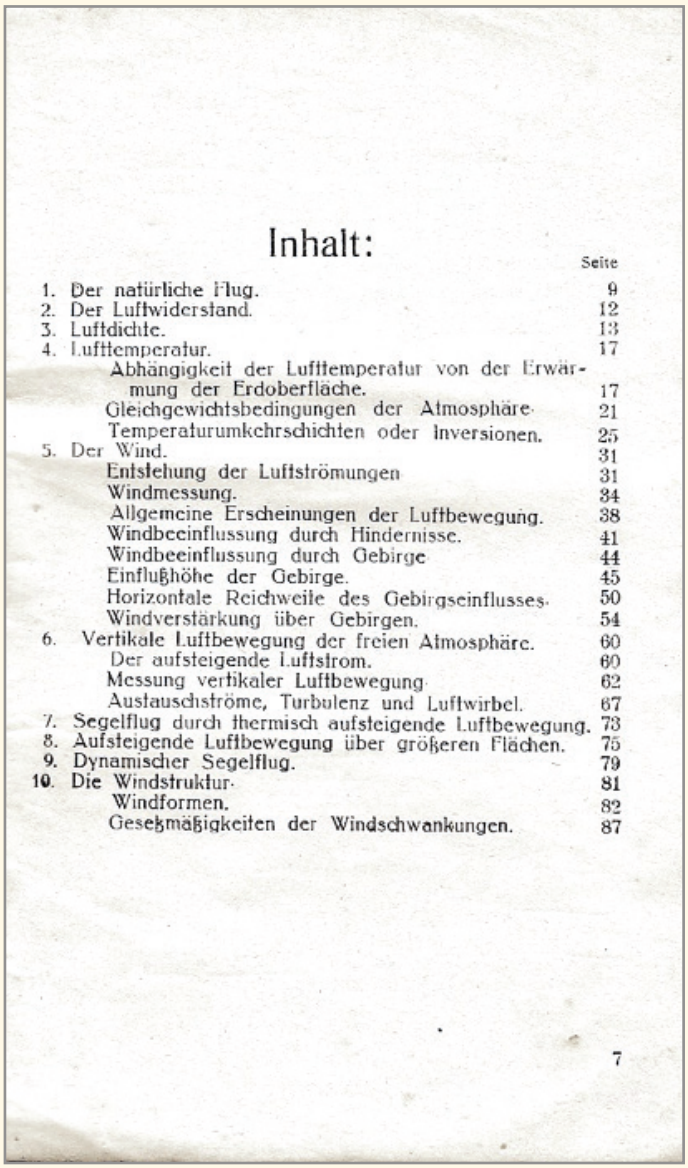

Inhalt:

7

Figure 1: Cover and table of contents of the booklet

In fact, Professor Walter Georgie published a booklet dealing with glider meteorology as early as 1922. The title: THE GLIDING FLIGHT AND ITS SOURCES OF POWER IN THE AIR! At that time, Walter Georgii was head of the weather service department of the Institute of Meteorology and Geophysics at the University of Frankfurt am Main as a private lecturer and a commissioned lecturer in aeronautical meteorology at the Technical University in Darmstadt. After studying physics, mathematics and geography, he had begun his professional career at the Royal Prussian Meteorological Institute in Berlin – he was fascinated by the forces of nature and the constantly changing weather patterns. Georgii then came into contact with aviation during the First World War: He was deployed as a consulting meteorologist with air units off Verdun and in North Africa (Egypt).

While working at the University of Frankfurt, he was concerned with the influence of mountains on the wind and the slope wind. Inspired by his work as a meteorological advisor

HISTORY

Prof. Walter Georgii:

100 years of glider meteorology

Some people will do the math: 100 years ago? So 1923? In 1922 - at the 3rd Rhön competition - the first engine-less hourly flight on a slope was achieved (Arthur Martens on the Vampyr from Hanover). The possibility to stay in the air over longer distances without an engine and without an upwind on the slope was not even considered at that time!

Text: Detlef Müller

at the Rhön competitions in 1920 and 1921, he began to think about the use of other potential energy sources for motorless flight: He was interested in the use of scientific and technical knowledge. He then summarized the result in the aforementioned booklet (DIN A5, 88 pages), which he published in mid-1922.

With this first book on glider meteorology, Georgii wanted to deal with the „meteorological problems of gliding“ and to „convey to glider pilots the state of knowledge of atmospheric processes and phenomena at that time“. And this in a form, „that everyone, who is to some extent familiar with the basics of physics, can effortlessly read into the matter“ (quotes from the preface). Thus, he deals in an introductory way with the basic physical elements of meteorology, which are still taught today in the first three chapters of theoretical glider training (air pressure, air temperature, air density, wind and thermodynamics, see also ***Fig.1***).

The only thing missing at that time was the realization that

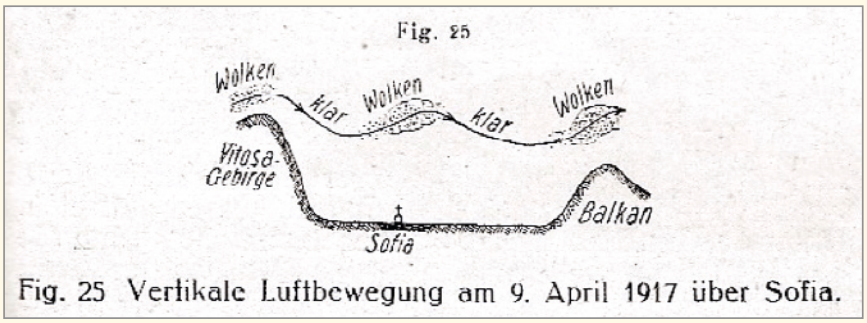

Figure 2: Illustration of the vertical air movement on April 09, 1917 over Sofia. „So over Sofia there was an ascending air movement up to 2500 m, which changed into descending flow between 2500 and 2900 meters. At a distance of 12.5 km from the observation site and at an altitude of 3000 m, ascending air movement began again. Schematically, the air flow over the valley between the Vitosa and Balkan Mountains is shown in the picture above. As can be seen, the ascending air movements are associated with cloud formation as a result of the cooling that occurs in this process."

on radiation days the convection layer is completely mixed and thus up to the cumulus condensation level the atmosphere is uniformly dry-adiabatic mixed, temperature gradients for lift thus no longer play a role here. In addition, the humidity of the air is not mentioned. At that time, the role of humidity for gliding could probably not yet be foreseen.

As expected, a somewhat larger part of the booklet is devoted to the wind and its influence by obstacles and mountains. The influence of mountains on the flow as well as the extent and strength of the sinking of the air in the lee were treated intensively. Georgii also describes lee effects such as lee vortices and lee waves in the mountains on the basis of field measurements (***Fig. 2***). However, Georgii did not (yet) speculate about the possibility of a gliding use of lee waves.

Georgii then deals with thermals in two chapters. He describes the phenomenon of „convection, the vertical exchange of air by rising warm air and simultaneous descent of colder air at a neighboring location" (***Fig. 3***). Using tethered balloon and cloud observations, he substantiated his account of convection with strongest rise under cumulus clouds and turbulence at the edge. Balloon measurements showed a climb in the updrafts of about 0.5 m/s. „The individual updrafts were located in different parts of the atmosphere each time. They formed ‚chimneys' or ‚vents' of the atmosphere into which the balloons were gradually ... were drawn into. ... Very nicely, these ascents again show the increase in vertical motion as the cloud is approached."

Georgii then considered the use of convection by human gliding. He concluded at that time that in our latitudes the vertical speeds would not be sufficient „to maintain gliding by the lift of vertical air movements alone": With an inherent sink rate of the gliders of the time of about 2 m/s, corresponding climb would also be required, which is probably „only relatively rarely achieved on normal days." „The skill of our aviators and the maneuverability of our gliders, however, should not be sufficient to keep the glider permanently in the limited air chimney and to pull it up in tight turns, as apparently the birds are able to do. From this point of view, it seems impossible to maintain human glider flight permanently by means of the thermal upward movement of the air. Its utilization can only be an occasional one, as often as it makes itself felt in flight. Perhaps one can draw a small benefit from the indication that under the individual cumulus clouds regularly ascending movement is encountered, so that one can therefore use this cloud as a signpost to the chimneys in the atmosphere.".

In gliding circles, until 1922, no possibility had been seen to stay in the air over longer distances without propulsion and away from mountain slopes. There were, however, clear indications from Kurt Wegener, also in 1922 (see Kottmeier, 2023), that the updrafts would certainly have to be strong enough for gliding. But they were dismissed by the fact that there would be no possibility to reach these updrafts with a glider and to climb in them in tight turns. This changed in the following years – not least due to the activities of Georgii and the first thunderstorm flight at the Rhön competition in 1926.

The first to fly out thermals were the Darmstadt student Johannes Nehring and the Austrian Robert Kronfeld. On April 30, 1928, Nehring succeeded in circling a thermal updraft for the first time on behalf of Walter Georgii (by then head of the research institute of the Rhön-Rossitten-Gesellschaft Wasserkuppe and the chair of meteorology at the TH Darmstadt). Robert Kronfeld carried out a series of thermal

glider flights starting in May 1928, and just one year later (on May 15, 1929) he became the first glider pilot to fly over the then dream limit of 100 kilometers.

But Georgii also dealt with other potential sources for motorless flight in the booklet. Thus, he devoted a separate chapter to the topic of „convergences". Here, he considered the vertical flow component of atmospheric convergence currents, which, at an estimated 0.2 m/s, did not appear to be usable for glider flight.

The last chapter deals with the possibility of dynamic gliding. He calculated that with sufficient shear, dynamic soaring should also be possible in a glider and considered various types of gusts as a potential source for this. That was in 1922. In 1974, 52 years later, Ingo Renner succeeded in performing dynamic gliding flight for the first time. Georgii had not suspected that there could also be sufficiently large shears at an inversion.

The booklet „Gliding and its sources of power in the sea of air" fell into my hands a few weeks ago. And as a glider pilot and meteorologist, I can only say: It thrilled me! I was amazed how topical wide passages of text still sound today. The booklet proves that Georgii had the ability to classify and summarize meteorological observations and phenomena in such a way that actually everybody can follow his explanations. And he knew how to inspire and thus get others to try out the possibilities for motorless flight that he had pointed out. ♦

Sources:

Prof. Walter Georgii, „*Glider Flight and its Sources of Power in the Sea of Air*" (available in German only).

Ch. Kottmeier: „*100 years of thermal soaring – a vision comes true*", Vintage Glider Club News, 2023, in print.

Figure 3: Georgii's description of thermals, convection

Leichte Cumulus- oder Haufenwolken.
(Jede Wolke bildet den Gipfel eines kaminartig aufsteigenden Luftstromes.)

6. Die vertikalen Luftbewegungen der freien Atmosphäre.

Der aufsteigende Luftstrom. Unsere Betrachtungen über aufsteigende Luftbewegung beschränkte sich seither auf das erzwungene Aufsteigen der Luftmassen an Gebirgen. Die treibende Kraft sind hierbei die horizontalen Luftdruckunterschiede und das Beharrungsvermögen der durch die Luftdruckdifferenzen in Bewegung gesetzten Luftmassen. Aber auch ohne horizontale Druckunterschiede und horizontale Luftversetzung können vertikale Luftbewegungen auftreten. Unter der Einwirkung der Sonneneinstrahlung kann die dem Erdboden auflagernde Luft örtlich stark erwärmt werden. Infolge ihres geringeren spezifischen Gewichts

60

muß diese erwärmte Luft aufsteigen, während als Ersatz kältere Luft der Höhe niedersinkt. Wir erhalten auf diese Weise den Vorgang der Konvektion, des vertikalen Luftaustausches durch aufsteigende warme und gleichzeitiges Niedersinken kälterer Luft an benachbarter Stelle. Die Vorstellung hat lange vorgeherrscht und findet sich auch heute noch vielfach in der Flugliteratur, daß der sogenannte aufsteigende Luftstrom eine aufsteigende Bewegung der Luft in ihrer ganzen Masse ist und in großer flächenhafter Ausdehnung vorkommt. Diese Annahme widerspricht durchaus der Kontinuität, die in einer strömenden Masse herrschen muß. Die vertikalen Bewegungen vollziehen sich vielmehr in einem räumlich und zeitlich rasch wechselnden Austausch aufsteigender wärmerer und niedersinkender kälterer Luftsäulen. Die aufsteigenden Luftteilchen wachsen erst in größerer Höhe zu Luftballen zusammen, die ausgedehntere Luftmassen in ihre aufsteigende Bewegung hineinziehen. Findet an einer Stelle ein anhaltenderes Aufsteigen von Luftteilchen statt, so übt diese Stelle eine ansaugende Wirkung auf die Umgebung aus. Aus der Nachbarschaft werden andere Luftteilchen herangezogen und mit in die aufsteigende Bewegung einbezogen, so daß sich allmählich eine kaminartige Luftströmung ausbildet. Die Lage dieses Kamins ändert sich schnell. Am oberen Ende des Kamins entwickelt sich gewöhnlich infolge der dynamischen Abkühlung der aufsteigenden Luft eine Cumulus- oder Haufenwolke. Einzelne Haufenwolken an sonst ziemlich heiteren Tagen kennzeichnen also immer die Stellen der Atmosphäre, wo Kamine aufsteigender Luftmassen vorhanden sind. Das Ineinandergreifen und die Abhängigkeit der auf- und absteigenden Luftbewegung von der Bodenbeschaffenheit stellt Fig. 26

Fig. 26

Konvektionsströmung an einem windstillen, heiteren Tag.

61